Heating Systems

Introduction

Heating systems are an essential part of every home, providing comfortable temperatures during cold weather. In Alberta, more than 90 per cent of heating systems are fuelled by natural gas. Annual space heating costs in typical homes using conventional equipment are from $300 to $700 depending on heat loss, size and lifestyle of the family, and heating system efficiency.

Maintaining the space heating system helps ensure that the energy is used efficiently. Most maintenance, including minor adjustments to the heating system are simple enough for the average homeowner to do. The efficiency of a well-maintained, properly operated system can be 10 to 15 per cent greater than a poor one.

If the heating system is in need of replacement, equipment manufacturers have developed energy-efficient equipment which can significantly reduce heating bills. This publication will help you assess your present heating system and choose new equipment that will be cost-effective and energy-efficient. Information on getting top performance from and the maintenance of your heating system is included.

The Question of Efficiency

House size, lifestyle, insulation levels and construction quality influence your annual heating costs. Annual costs are also affected by the efficiency of your heating equipment. The efficiency is determined by the maintenance, type and size of equipment. Incomplete combustion and heat loss in the venting system result in a percentage of the fuel being used

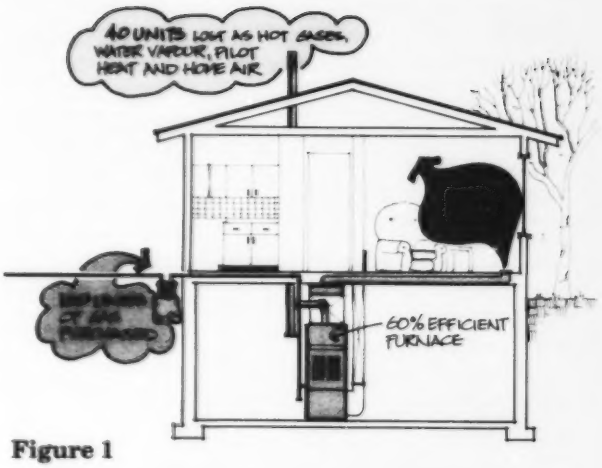


Figure 1

to heat the home. (Figure 1). This percentage is referred to as efficiency. For example, a furnace that uses only 60 of every 100 units of energy to heat the house is 60 per cent efficient.

Two terms commonly describe the efficiency of heating equipment: seasonal efficiency and steady-state efficiency. **Seasonal efficiency** is an indicator of how a heating system performs over the entire heating season. The cycles of starting-up, running and cooling off -- all under different weather conditions -- reduce a system's efficiency. The constantly burning pilot light and chimney heat loss also contribute to reduced efficiency. **Steady-state efficiency** is measured under laboratory conditions with the appliance warmed up, running steadily, ideally tuned, adjusted and in clean operating condition. This is the efficiency stated by the manufacturer and is higher than seasonal figures. **It is seasonal efficiency that is the true indicator of how well a heating system performs.**

Selection

Space Heating

In 94 per cent of Alberta homes, heat is delivered as circulated warm air through a central forced-air system. Other homes may use room-by-room heaters, woodstoves or in-floor heating and rely on radiation and convection to distribute the heat. In some homes, systems combining methods of heat delivery are used.

Forced-air systems

A central forced-air system consists of a furnace with a fan to heat and circulate air, supply ducts to carry warm air to each room and return ducts to draw cool air back to the furnace (Figure 2). Furnace operation is regulated by a centrally located thermostat. A big advantage of forced air systems is that furnaces which can use virtually any energy source are widely available and reasonably priced.

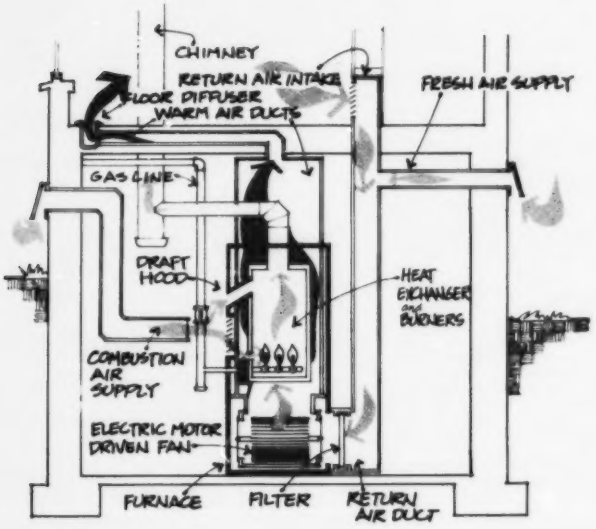


Figure 2

With a forced air system, house air can easily be humidified, filtered, heated or cooled. If the furnace fan is run continuously, circulated air maintains uniform temperatures throughout the house. This can balance spot overheating caused by solar radiation or a woodstove or fireplace.

When replacing a furnace motor or buying a new furnace, look for multi-staged motor speed settings. Continuous operation at a lower setting creates fewer drafts, is less noisy and less expensive to operate.

Forced-air gas furnaces come in three types: conventional, medium-efficiency and high-efficiency. **The higher the efficiency, the greater the percentage of heat will be delivered per unit of fuel used.**

Conventional furnaces (Figure 2) are the most commonly used. Their main disadvantage is low seasonal efficiency of 50 to 60 per cent due primarily to chimney heat loss. In a conventional furnace, 10 cubic feet of warm house air are required to efficiently burn one cubic foot of gas. An additional 10 to 14 cubic feet of house air are drawn into the furnace through the draft hood and, along with gases from combustion are exhausted outside through the chimney.

Warm house air is lost up the flue and replaced by cold outside air leaking in through the house shell--air which then must be heated. This significantly reduces the efficiency of the system.

Efficiency has improved somewhat in **upgraded conventional furnaces** with electronic ignition and automatic flue dampers. Electronic ignition improves combustion efficiency by five to seven per cent by replacing the constantly burning pilot flame with a device which ignites only when the thermostat calls for heat. The automatic flue damper reduces heat loss up the chimney by blocking the flue when the furnace is not operating. This increases efficiency by two to eight per cent depending on the tightness of the closed damper. The large volume of dilution and combustion air is still required when the furnace is operating.

Medium-efficiency furnaces combine an induced draft fan (which replaces the draft hood) and electronic ignition to achieve seasonal efficiency of about 75 per cent (Figure 3). The fan draws a controlled amount of combustion air into the furnace and forcibly exhausts combustion gases outside through a three-or four-inch diameter vent, eliminating the need for dilution air and increasing efficiency. In some models the vents can be taken straight through the outer wall eliminating the need for a standard chimney.

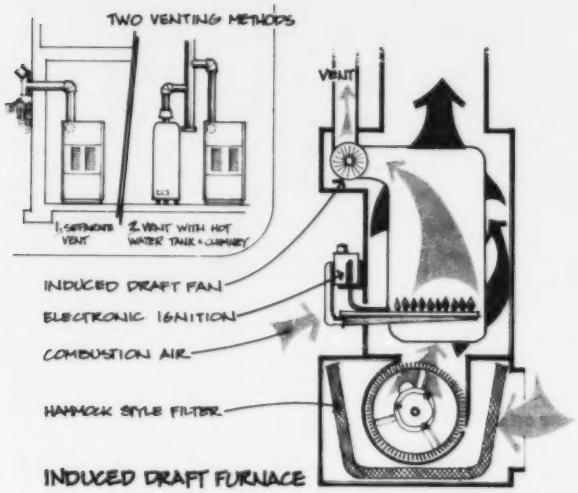


Figure 3

Another medium-efficiency furnace has the combustion unit outside the house. Its advantage is that house air is not required for combustion. The unit circulates a heated glycol/water solution to an indoor blower-coil which distributes the warm air.

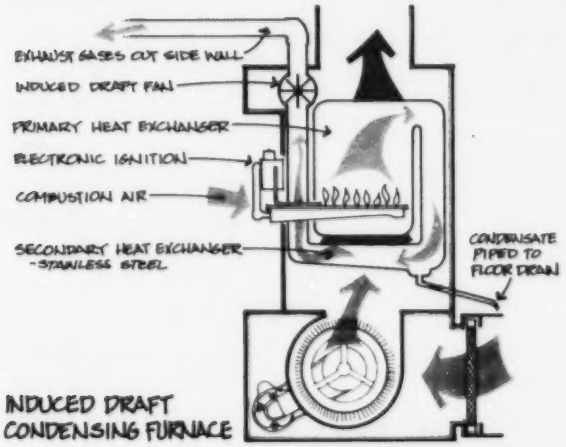


Figure 4

High-efficiency furnaces, in addition to induced draft operation and electronic ignition, have an extra heat exchanger which extracts more heat from the combustion gases (Figure 4). Exhaust gases are vented outside through a two-inch diameter flue. When the temperature of the gases falls below a specified level, water vapour condenses and releases additional heat. These furnaces are referred to as condensing furnaces. The condensate, mildly acidic and corrosive, is piped to a floor drain. All furnace parts which are in contact with it are of materials highly resistant to corrosion. (i.e. The extra heat exchanger, may be of aluminized steel or stainless steel or ceramic-coated steel and the exhaust flue of plastic.)

Another high-efficiency condensing furnace uses a combustion technique "pulse combustion" (Figure 5). The force of the pulse rather than a fan induces movement of combustion air into, and exhaust gases out of, the unit through PVC tubes. With combustion air drawn directly from outside, loss of house air during furnace operation is eliminated.

Efficient heat exchange and the absence of a chimney contribute to condensing furnaces seasonal efficiency of 90 to 95 per cent.

Table 1 summarizes advantages, disadvantages, expected seasonal efficiency, sizes and costs of various types of gas-fired furnaces.

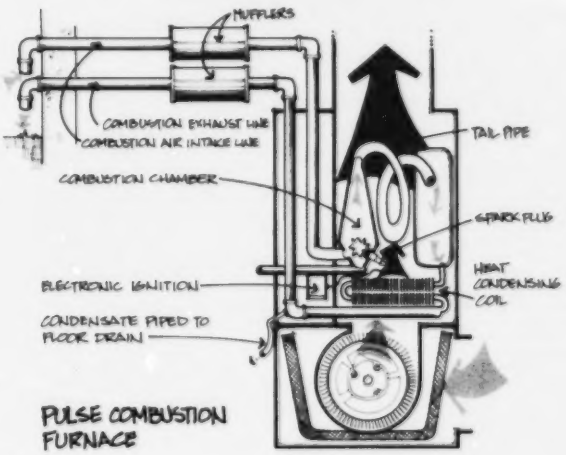


Figure 5

Table 1

Comparison of Gas Furnaces

Furnace Type	Features	Seasonal Efficiency	Advantages	Disadvantages
Conventional	• Standing pilot ignition	50% to 60%	• Widely available • Less complicated therefore easily repaired	• Constant heat loss through open chimney flue • Pilot flame burns constantly
Conventional (upgraded)	• Automatic flue damper • Electronic ignition	57% to 73%	• Chimney flue closed when furnace not operating • No pilot flame	• Open flue when furnace operating
Medium-Efficiency	• Induced draft fan • Electronic ignition • Some models have an outside combustion unit	75% to 79%	• Chimney flue through roof or wall or not required • Can be jointly vented with water heater • No pilot flame • Combustion air requirements reduced • No house air required for combustion on some models • System can also be used to heat water on some models	• Can increase household humidity level
High-Efficiency	• Additional or unique heat exchanger	90% to 95%	• Extracts heat from flue gases • Chimney flue through roof or wall • No pilot flame • Some models use outside air for combustion • Eliminates possibility of backdrafting	• Requires side-wall vent and drain installation • Cannot be jointly vented with hot water heater • Condensate is slightly acidic and corrosive • Can increase household humidity level

Wood-and coal-burning furnaces operate in much the same way as gas furnaces and can be controlled by a centrally located, wall-mounted thermostat. Efficiencies are typically around 60 per cent but vary with the moisture content of the wood used. When these fuels are readily available and less expensive, it may be economical to use a wood-or coal-fired furnace.

Substantial time will be required for fuel handling and maintenance. The heat exchanger and chimney must be inspected and cleaned regularly, and ashes disposed of carefully if the heater is to operate safely and efficiently. In general, if you cannot obtain wood for less than $50/cord, it is more economical to use natural gas.

Add-on wood or coal furnaces are available and approved. They are similar to wood furnaces but designed to connect to another furnace. The warm air plenum of the furnace is connected to the add-on, and the fan circulates air through both units (Figure 6). Electrical controls are supplied and result in an electrical system similar to those on combustion furnaces. The major problem with add-ons is the stringent requirements on clearances do not allow you to use the existing ductwork of a gas heating system.

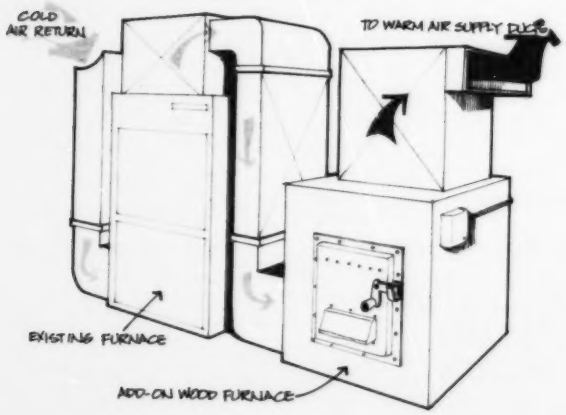


Figure 6

Combination furnaces use two different fuels (wood and oil, or wood and electricity). Costs can be reduced by using inexpensive wood or coal most of the time and only using the automatic back-up system when the house is left unattended for extended periods or to supplement in order to meet heating requirements.

Safety and quality installation are crucial when considering a solid fuel-burning appliance for supplemental heating. Strictly adhere to the following:

- Choose a unit that is not too large for the space to be heated.
- Ensure the appliance is certified and labelled by the Canadian Standards Association (CSA), the Underwriter's Laboratory of Canada (ULC) or Warnock Hersey.
- Ensure installation meets local building codes and fire safety regulations. Manufacturer's recommended chimney and duct clearances to combustible materials are critical.
- Check your fire insurance. You may be required to pay a surcharge to cover the new heater.

Electric furnaces are of similar design to gas-fired units, but use electric elements to heat the circulating air stream. The units are 100 per cent efficient as combustion inefficiency and chimney losses are eliminated. Although inexpensive to purchase, they are seldom used in Alberta because of the high cost of electricity compared to natural gas.

Radiant and Convective Systems

A number of space heating systems rely on radiation and convection to distribute heat. The most common is the hydronic or hot water type. Older gravity hot water systems slowly move a large volume of 40°C (100°F) water through large cast iron radiators by natural convection. Modern systems use a circulation pump to quickly move a small volume of 80°C (180°F) water through smaller finned convector radiators (Figure 7). These have smaller pipes and radiators than the gravity systems. When considering conversion or replacement be sure all components of the old and new systems are compatible.

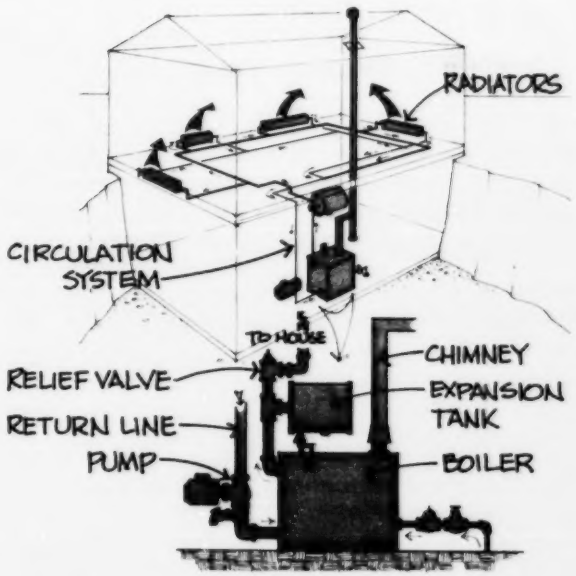


Figure 7

Hot water (usually a mixture of water and ethylene glycol) is generated by a boiler using natural gas, propane, oil, electricity, wood or coal. Boilers are available in a range of efficiencies and prices. Conventional boilers have seasonal efficiencies of 60 to 65 per cent. If these are upgraded by adding electronic ignition and a flue damper, efficiency can be improved to about 75 per cent.

Medium-efficiency boilers draw combustion air from the outside with seasonal efficiency of about 80 per cent. High-efficiency boilers using pulse combustion achieve over 90 per cent efficiency.

System efficiency can be increased by adjusting the operating temperature to reflect the house's demand for heat and the outside temperature. This is done manually or with a controller. It is also possible to zone areas of the house to different temperature levels, keeping seldom used areas at a lower temperature.

Radiant floor heating is another hydronic system. Usually practical only in new house construction, it circulates hot water from a boiler through tubes embedded in the concrete floor of a lower level and between the floor joists of upper levels (Figure 8). Theoretically, the system provides the most comfort as it keeps the floor warm while maintaining a cooler temperature at head level. **It is wise to insulate below the concrete floor slab to prevent heat loss to the ground.** Heat transfer into the house is most effective when floors are tiled or lightly carpeted.

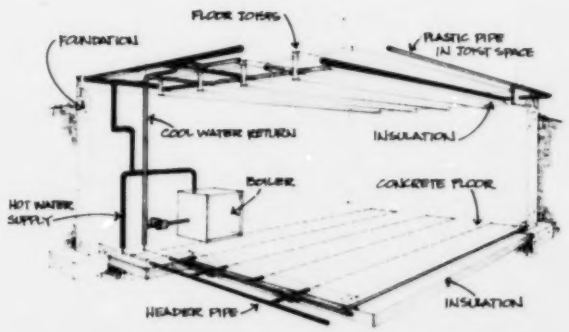


Figure 8

Electric baseboard or ceiling heating systems normally consist of individually controlled modules. Electric baseboards rely on convection to distribute heat. Ceiling panels rely on radiation. Although reliable, they are expensive to operate compared to natural gas.

Airtight woodstoves can be effective space heaters in small, well-insulated homes or in large open areas where air circulation is good. There are two common types: radiant stoves and circulating stoves. The radiant stove heats energy from its hot surface and relies on convection currents in the room to distribute the heat. With a circulating heater, the hot surface is encased in a vented metal shell and air is circulated by natural convection or a fan delivers heat to the room. A central location will increase the effectiveness and heat distribution of the stove.

Modern woodstoves have airtight doors and an outside combustion air inlet. The rate of combustion, and thus the heat output, are controlled by screw-in draft caps or thermostatic controls and efficiency ratings up to 70 per cent can be achieved.

Correctly sizing the unit is important. As a general rule, think small. An oversized stove produces too much heat and the tendency will be to operate the stove at low combustion rates. This causes tar-like and inflammable creosote deposits to form in the stovepipe and flue. If the unit is too small, frequent overfiring may result in safety problems. Know the dimensions and insulation levels of the area you need to heat and have an experienced wood-heating retailer assist in selecting an appropriate heater.

As with all furnaces, be sure the woodstove is certified to Canadian standards and that installation meets local building codes and fire safety regulations.

Manufacturer's recommended clearances to combustible materials must be adhered to strictly.

Other Systems

Combination hydronic and forced air systems look promising for the future. In one type, a high-efficiency boiler supplies hot water to a heating coil in the air plenum (Figure 9). Air, forced past the heating coil by a fan, is heated and distributed as in a forced-air system. The boiler can also heat a hot water tank (the tank would not need its own combustion unit).

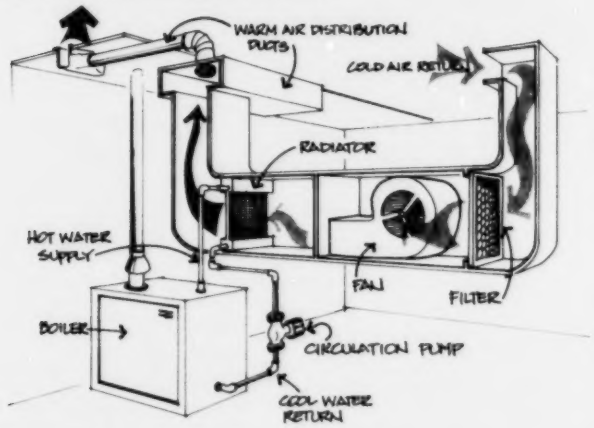


Figure 9

You may have heard of **heat pumps**. While they are practical in more moderate climates for heating and air conditioning they are less appropriate in the extreme temperatures of Alberta. Their high initial cost coupled with high electrical prices make them a doubtful investment at this time.

Deciding If You Need a New Heater

Do not be too hasty in condemning your existing heater. Have it inspected by your local utility or a qualified heating contractor. If it is in good shape, large enough for a planned addition, and still operating safely and efficiently, replacing it may not be economical. Furnaces should last 15 to 20 years, boilers slightly longer.

For homes with forced-air systems, there are situations when buying a new furnace is a good idea. The existing furnace may be worn out. An inspection may reveal serious problems, best remedied with a new unit. Such problems would include holes or cracks in the heat exchanger, burner deterioration, rusting of structural components or blower failure. Older furnaces that have been converted from other fuels to natural gas or from gravity to forced air may have parts or components that are impossible to replace. Chimney leaks, condensation from improperly operating temperatures or humidifier overflows may have contributed to the problems.

For safety reasons, remember that any problem that allows combustion gases to escape into the home must be remedied immediately to avoid dangerous health and safety problems. Contact your gas company representative immediately if you suspect any exhaust leaks.

If you include extensive caulking, weatherstripping and additional insulation when renovating you may drastically lower your fuel needs. As a result the existing heater may be too large. When you replace your heater, a smaller one will better suit your needs. If you plan to remodel or build an addition, your heating requirements will increase. The existing heater may be too small to meet the demand and replacing it with a larger, more efficient one may be required. If, however, the home and addition are brought up to energy-efficient building standards, the existing heater may well be large enough. Leave it in place through one winter and see if it is adequate.

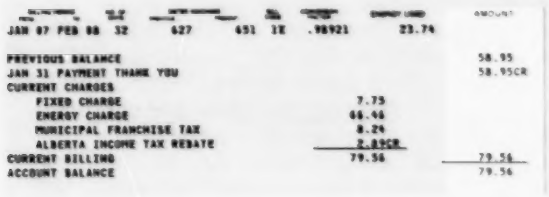
Selecting a New Space Heater

When purchasing a new heater, keep the following points in mind to help ensure the unit you purchase will be efficient and suited to your needs.

- **Properly insulate, caulk and weatherstrip your home before purchasing a new space heater.** Your heating requirements and, therefore, the size and cost of your heating system will be significantly reduced.
- **Closely compare various units.** There is a wide variety of heaters available. Compare energy-efficient features, seasonal efficiencies, installation and operation costs, ease of maintenance, availability of parts and service and warranties.
- **Avoid oversizing.** Your present heater is probably oversized, especially if you have weatherized your home. Properly sized, a heater will run more efficiently and provide greater comfort.
- **Look for hidden costs.** A quotation to replace a gravity system with forced air may be $2000 - $2500. This may not include plumbing changes, concrete to fill the hole in which the furnace was sitting and removal of the old cast iron unit.
- **Consider upgrading your energy source at the same time.** If you are heating with propane or oil, it may be more economical to switch to natural gas or wood. Have a qualified heating contractor help you determine the total installed cost of various alternatives.

There is a large selection of furnaces, boilers, woodstoves and combination units. Quoted efficiencies vary widely as do prices. As the efficiency of the heaters increase, generally so does the cost. Whether it is worthwhile to spend extra on a high-efficiency heater depends on what you are now paying to heat your home.

The easiest way to calculate your annual space heating costs is to total your monthly gas utility bills. If you have not saved them, contact your gas or fuel supply company for rates and request a record of your consumption over the previous year.



							AMOUNT
JAN 07	FEB 08	32	627	451	1E	.98921	23.74
PREVIOUS BALANCE							58.95
JAN 31 PAYMENT THANK YOU							58.95CR
CURRENT CHARGES							
FIXED CHARGE						7.75	
ENERGY CHARGE						66.46	
MUNICIPAL FRANCHISE TAX						8.29	
ALBERTA INCOME TAX REBATE						2.89CR	
CURRENT BILLING						79.56	79.56
ACCOUNT BALANCE							79.56

Figure 10

Follow these steps:

1. **Total the "energy charge" costs from your statements for a one-year period (Figure 10).** Do not include fixed charges or taxes.

2. **Add together gas costs for appliances other than space heating.** Table 2 lists appropriate operating costs for other gas appliances you may be using. Select a number within the range based upon how much you use these appliances.

Table 2

Operating Costs for Gas Appliances

Gas Appliances	Average
Water Heater	$80 - $120
Range	$25 - $ 35
Dryer	$20 - $ 30
Gas Light	$50 - $ 60

3. **Determine space heating costs.** Subtract 2) from 1). The result will be an estimate of your annual space heating costs. Using this figure, and Table 3, examine fuel cost savings due to increasing combustion efficiency. Compare these savings to the higher initial cost of more efficient units to determine if your investment is worthwhile.

For example: two different homes, both use conventional heaters with efficiencies of 55 per cent but each have different space heating costs. The homeowner is wondering whether to purchase a medium-efficiency furnace with a seasonal efficiency of 75 per cent or a high-efficiency unit with an efficiency of 90 per cent.

Table 3

Savings for Every $100 Fuel Costs*
By Increase of Combustion Efficiency

From Original Efficiency of:	To Increased Combustion Efficiency of:								
	55%	60%	65%	70%	**75%**	80%	85%	**90%**	95%
50%	$9.10	$16.70	$23.10	$28.60	**$33.30**	$37.50	$41.20	**$44.40**	$47.40
55%		**8.30**	**15.40**	**21.50**	**26.70**	**31.20**	**35.30**	**38.90**	**42.10**
60%			7.70	14.30	**20.00**	25.00	29.40	**33.30**	37.80
65%				7.10	**13.30**	18.80	23.50	**27.80**	31.60
70%					**6.70**	12.50	17.60	**22.20**	26.30
75%						6.30	11.80	**16.70**	21.10
80%							5.90	**11.10**	15.80
85%								**5.60**	10.50
90%									5.30

* Assuming constant radiation and other unaccounted for losses

Case 1: Space Heating Costs $400/yr

Using Table 3, determine savings for every $100 of fuel costs in going from a conventional to a medium-efficiency or high-efficiency unit (see highlighted area).

Standard (55%) to:	Price Estimate (a)	Fuel Savings x $100's (b)	Payback (a) / (b)
Medium-Efficiency (75%)	500	26.70 x 4 = 106.80/yr	500 / 106.80 = 4.68 yrs.
High Efficiency (90%)	1400	38.90 x 4 = 155.60/yr	1400 / 155.60. = 9 yrs.

In this example, space heating costs are lower and the simple payback on the high-efficiency unit is at least nine years. With a longer payback, the investment becomes doubtful. In this case, therefore, the medium-efficiency furnace is probably the better choice.

Case 2: Space Heating Costs $700/yr

Using Table 3 as before:

Standard (55%) to:	Price Estimate (a)	Fuel Savings x $100's (b)	Payback (a) / (b)
Medium-Efficiency (75%)	500	26.70 x 7 = 186.90/yr	500 / 186.90 =2.68 yrs.
High-Efficiency (90%)	1400	38.90 x 7 = 272.30/yr	1400 / 272.30 =5.14 yrs.

In this example, although the initial cost of the high-efficiency heater is a great deal more than the medium-efficiency unit, high space heating costs will result in high fuel savings. The extra investment in the high-efficiency unit will be recovered in only five years -- a reasonable payback. In this case the high efficiency furnace will probably be a good investment. As a general rule, if heating costs remain high in the future, a high efficiency heater is the best solution.

Be aware, however, of the changing economics involved with heater replacements. Fuel costs will probably increase and heater prices may vary as production and competition increases.

Another thing to consider is that the cost of installing a new heater may be even higher if modifications to ductwork, alterations to the floor drain, or electrical changes are necessary. There may also be a size restriction if the original space is small. It is essential that a qualified heating contractor do the installation work following the requirements of the Alberta Building Code and the Gas Code.

Sizing the System

Once you have identified the type of heater to best suit your needs, it must be properly sized in order to operate efficiently and provide maximum comfort. **Older equipment is frequently oversized. If you have increased insulation levels and caulked and weatherstripped your home since the heating system was installed, this is even more likely.** As a general guide, there are two indications that your present system is too big.

1. During the coldest winter days, the heater cycles on and off frequently.

2. The heater delivers a large amount of heat over a short period of time causing discomfort due to large, frequent temperature fluctuations.

A properly sized unit will run almost constantly during the coldest weather. It is then operating at peak efficiency and giving you maximum value for your heating dollar. You can see, however, that even a properly sized heater will have more capacity than necessary for most days of the year when it will operate at less than peak efficiency. As a result, the more oversized it is, the less time it spends operating at or near peak efficiency.

It takes a qualified heating contractor to properly size a heating unit. Be sure that any of the following changes to the house are taken into account:

- Increased insulation levels in the attic, walls and basement
- Reduced air leakage due to weatherstripping and caulking
- Upgraded windows and doors
- Completed or planned additions to the house
- Heater performance and house comfort with the old unit

Know the size of your existing system. The "input" and "output" amounts are stamped on an identification plate inside the furnace access door (Figure 11). Size is measured in British Thermal Units per hour (Btu/hr) or the metric equivalent of kilowatts (kW).

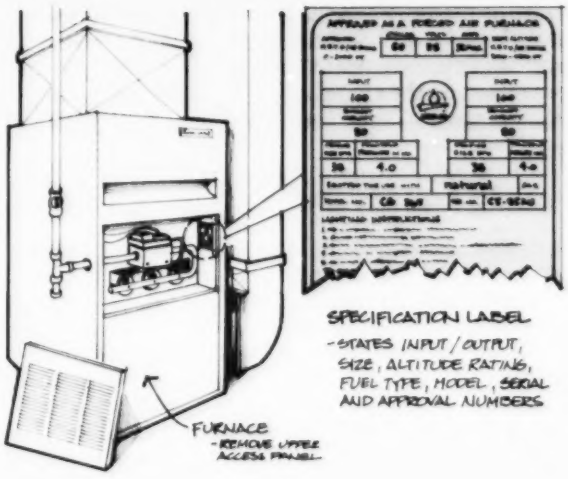

SPECIFICATION LABEL
- STATES INPUT / OUTPUT, SIZE, ALTITUDE RATING, FUEL TYPE, MODEL, SERIAL AND APPROVAL NUMBERS
FURNACE
- REMOVE UPPER ACCESS PANEL

Figure 11

The furnace "output" amount should be sized to the heat load of your house, not the "input" amount. Two furnaces with different efficiencies can have the same "input" amount but will have different "outputs".

Have contractors explain the choice of heater to you. **Simply guessing or duplicating the size of your old heater will rarely give you an efficiently sized heating unit.**

Choosing a Heating Contractor

Medium-and high-efficiency heater technology has become available on a large scale and is undergoing change and improvement. Not all heating contractors are familiar with the new units on the market and it is up to you to ensure that a qualified contractor is chosen to install and maintain your energy-efficient heater.

Consider the following suggestions:

- Collect names of contractors from friends and neighbours who have had a new heater installed recently. Ask if they were pleased with the installation and service work. Check the heater they had installed and ask how it is functioning.
- Determine the expertise of the contractor by asking about the differences between medium and high-efficiency heaters, the economics involved in purchasing each, advantages of various features, and how they operate.
- Obtain at least three written cost estimates from different contractors--suspect any that vary too much for an equivalent job. Details should include total price plus a labour and material breakdown, type of equipment to be installed and warranties. Remember, it is worth paying a little extra for a proper installation.
- Before selecting a contractor, ensure the firm is bonded, has a provincial licence and is adequately insured. You may also want to find out how long the firm has been in business by calling the Better Business Bureau. Check with your local utility about the work to be done to ensure all heating and ventilating codes are being satisfied.

No amount of advice will ensure a perfect installation, but following these steps will improve your chances of getting an acceptable one. Inspect the job before the contractor leaves and before making final payment. Check that all vents to the outside have been properly air-sealed. Remember, that by asking the right questions at the right time you will help ensure a better-than-average job.

Heating System Design for New Housing

For a heating system to provide a high level of comfort at an affordable price, its design, selection and installation must be given proper consideration when the home is being designed.

The type of system chosen will depend on the cost and availability of different fuels. Although most Albertans use natural gas, in some areas it is not readily available and alternative energy sources such as electricity, propane, coal or wood may be more practical.

Once the fuel type has been chosen, the system design should be based on:

- Ability to provide comfortable heating
- Availability of system components and servicing
- Installed cost
- Maintenance and operating costs

The method of heat distribution must also be chosen. Although forced air systems are used in most Alberta homes, radiant heating provides a high degree of comfort and has certain advantages. A comparison of these systems is given in Table 4.

Once the system is chosen, select a qualified heating contractor to ensure that the equipment is properly sized and installed and that provision has been made for adequate combustion air to the unit.

Table 4

Comparison of Heating Systems

	Forced-Air	Radiant
Advantages	• Forced circulation provides fresh air throughout the home. If furnace has a two speed fan, the low speed can be used year round to maintain humidity and air freshness • Humidifer can be incorporated into system • Using low fan speed; solar gains and heat from lights, appliances, etc., can be distributed • Air can be filtered easily • Widely used and easily serviced	• No drafts from forced air circulation • Provides high degree of comfort • Piping easily installed and concealed • Low maintenance • Clean and quiet • Individual room control possible • Even temperature distribution • Hot water supply can be tied into system • Takes less room
Disadvantages	• Annual, at minimum,servicing required • Filter requires monthly inspection • Noise • More drafts • Large ducts and furnace use lots of space when finishing a basement	• Possible water leaks • Heat distribution difficult, especially solar gains • Baseboard heaters interfere with decorating • Expensive to add air conditioning • Difficult to humidify air • More expensive

Maintenance

Safety

Family and personal safety is the primary reason for heating system maintenance. Remember: for safe operation, fuel-fired appliances need an air supply and must be properly vented to a chimney.

Visually inspect the vent connection pipes from the furnace, boiler and gas-fired water heater to the chimney (Figure 12). Check that all the joints are tight and securely fastened. Look for any rusted or "soft" spots in the pipes because harmful gases such as carbon monoxide may leak in through holes or gaps . Replace deteriorating pipes immediately. The top of the metal chimney should also be inspected periodically for deterioration.

Masonry chimneys must have metal or ceramic liners when used for exhausting gas appliances. Visually inspect the chimney lining with a mirror in the cleanout access, and check for blockages. Make sure all openings, except those servicing the furnace and hot water heater are closed off. This includes openings previously used for a kitchen range or gas space heater.

Signs of excessive carbon or rust deposits, escaping fumes or irregular flame patterns should be reported immediately to your gas company. **If there is gas odour, evacuate and ventilate the area. Avoid flame or electrical spark sources (light switches) while waiting for the utility company representative .**

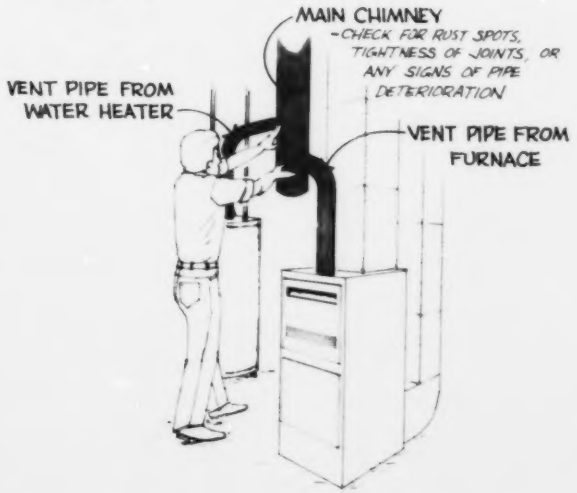

MAIN CHIMNEY
-CHECK FOR RUST SPOTS, TIGHTNESS OF JOINTS, OR ANY SIGNS OF PIPE DETERIORATION
VENT PIPE FROM WATER HEATER
VENT PIPE FROM FURNACE

Figure 12

Check for obstructions that reduce the combustion air supply to the furnace and hot water tank. It's important not to store things close to the furnace or hot water tank. Be sure these units are not enclosed in a small area without an air supply. Never operate them with any access panels removed.

Because houses are sealed better a shortage of combustion and draft air may result. **This causes combustion gases to be drawn back into the house, called backdrafting.** Exhaust fans, fireplaces, woodstoves and clothes dryers can further aggravate the problem. If you smell combustion gases near the furnace or hot water tank, or if a fireplace does not draw properly unless a window is open, backdrafting can be occurring. **Backdrafting is a serious health hazard and should be remedied immediately.**

Opening a window or a door provides a short-term solution. A permanent solution is to provide a combustion air inlet. A separate duct brings combustion air to the furnace and hot water tank from outside (Figure 2). This duct should not have a manual damper. However, the duct must be located within one foot vertically and two feet horizontally of the burners on the largest appliance, usually the furnace. To avoid the dumping of cold air, the duct must dump into a container or be equipped with an approved automatic damper or diffuser.

The size of the combustion line depends on several things, these include appliance rating and house construction. Consult the gas inspector, furnace contractor or the provincial inspection authority of Alberta Labour to determine the proper sizes for the ducts.

System Maintenance

In Alberta your home is probably heated with a natural gas-or propane-fired forced air, gravity or hot water heating system. Maintenance of different systems follows, but one common requirement is the need for fresh air for combustion and for proper chimney operation.

A lot of heat produced by a conventional furnace is lost up the chimney. This is necessary in order to properly vent combustion products. **Adding reclaiming devices to the flue to recover this heat is not only illegal but also dangerous.** It can cause water vapour to condense in the chimney and cause corrosion. Condensation may freeze and block the chimney in cold weather.

New medium and high efficiency furnaces are designed to safely recover heat from the flue gases. If replacing the furnace refer to the first section of this publication.

Forced Air Systems

A typical forced air system is shown in Figure 13. Proper and efficient operation depends on an unobstructed air flow through the furnace's air circulation system.

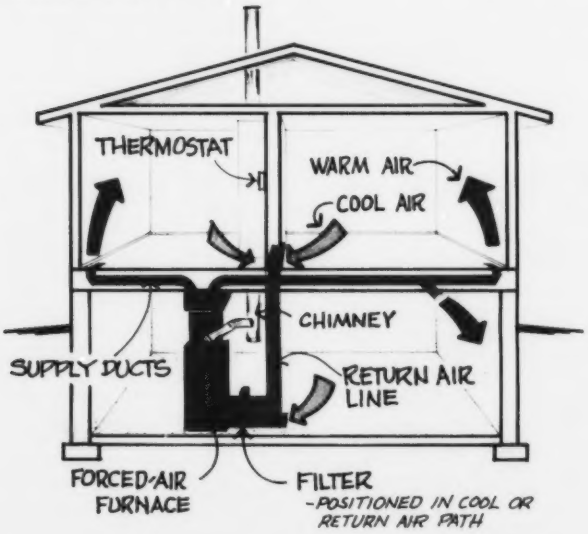


Figure 13

The easiest and most effective way to achieve this is to keep the filter clean. If the filter becomes clogged and dirty, air movement slows and efficiency drops because heat is not removed from the heat exchanger fast enough. Reduced air flow also results in poor heat distribution, especially in rooms furthest from the furnace.

The most common styles of filters are shown in Figure 14. Disposable filters of cardboard and fibreglass should be changed monthly during the heating season. Permanent filters should be cleaned monthly by vacuuming or washing. Other types, such as electronic or charged media, should be maintained as specified by the manufacturer. Usually they will require monthly cleaning during the heating season.

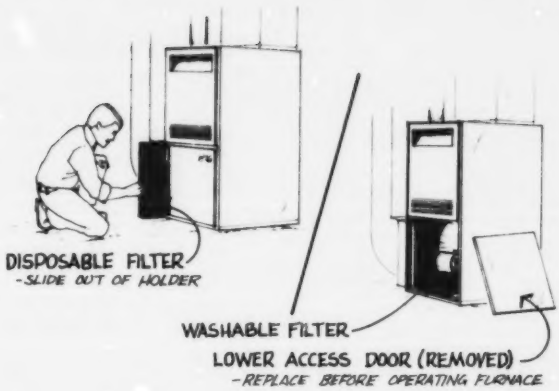


Figure 14

Keeping the entire duct system clean will prevent the filter from clogging frequently. Remove the registers (diffusers) and vacuum the duct as far as you can reach. Hire a commercial furnace cleaning service for heavier amounts of dirt.

Air flow also depends on the condition of the motor and blower. Lubrication of the bearings should be the only maintenance required. **Turn off power to the furnace, then remove the lower access panel to the motor and blower assembly.** Twice a year add two or three drops of non-detergent electric motor oil to each oil port (Figure 15), more often if the fan is running continuously. If there are no oiling ports the motor and blower have sealed bearings and require no lubrication.

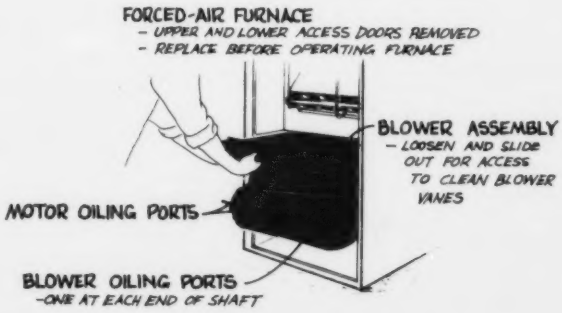

FORCED-AIR FURNACE
- UPPER AND LOWER ACCESS DOORS REMOVED
- REPLACE BEFORE OPERATING FURNACE
BLOWER ASSEMBLY
- LOOSEN AND SLIDE OUT FOR ACCESS TO CLEAN BLOWER VANES
MOTOR OILING PORTS
BLOWER OILING PORTS
-ONE AT EACH END OF SHAFT

Figure 15

If the fan is not directly driven (with the motor mounted inside the fan assembly), check the belt drive between the motor and blower fan. Proper tension is set by changing the angle of the motor. There should be 20 to 30 mm, (¾ to 1¼ inches) of slack in the belt midway (Figure 16).

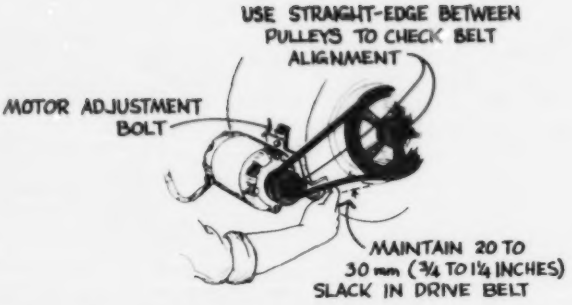

USE STRAIGHT-EDGE BETWEEN PULLEYS TO CHECK BELT ALIGNMENT
MOTOR ADJUSTMENT BOLT
MAINTAIN 20 TO 30 mm (¾ TO 1¼ INCHES) SLACK IN DRIVE BELT

Figure 16

Examine the belt condition and alignment. **Make sure the power is off.** If the belt is cracked, frayed or worn replace it. Loosen the motor, remove the worn belt, install a new one of the proper size and adjust to the proper tension. Use a straight-edge or look along the belt to see that the pulleys are lined up properly. If pulleys are not aligned, loosen the motor pulley, slide it along on the shaft, then retighten the pulley. Keep a spare fan belt for emergency replacement.

When the lower access panel of the furnace is off, look at the blower vanes. Soil buildup on the vanes will impede efficient operation and air flow. Loosening a few bolts will usually expose the assembly enough to scrape and vacuum the blower vanes.

To completely clean the blower, remove it entirely, disconnect the motor, and wash the blower at a coin operated car wash. This removes built-up grime on the vanes. Remount the blower/motor assembly, replace the lower access door and turn the power on.

Do not operate the furnace without all access doors in place.

Inadequate air flow can cause the furnace burners to cycle on and off, reducing operating efficiency. One cause is the blower running too slowly. The fan speed can be increased by changing the diameter of the motor pulley or by tightening the belt if it is loose and slipping. **Remember to turn the power off before making any adjustments.** Most motor pulleys are variable-speed types and can be increased by loosening a locking screw, twisting the pulley halves closer together, and then retightening the screw (Figure 17). Adjust the pulley in small steps until frequent burner cycling stops. With a direct drive motor no adjustments are necessary but the motor should be oiled regularly.

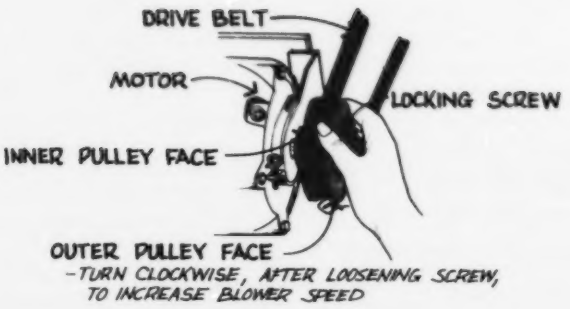


Figure 17

Inefficient furnace cycling can be reduced by adjusting the anticipator setting in the thermostat (Figure 18). It is a small movable arm or dial inside the body of most thermostats. Moving it to a higher setting or in the direction marked "longer" increases the temperature range. The furnace will run less frequently and will burn less fuel. Adjust the anticipator bit by bit over a week to find the optimum point. If it is too cool before the furnace comes on reduce the anticipator setting.

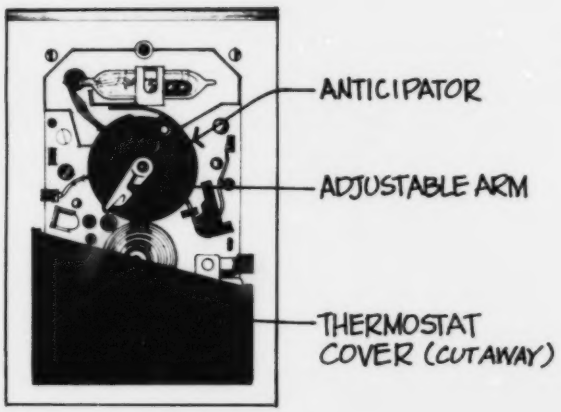


Figure 18

If the blower cycles on and off frequently, adjust the fan-control limit switch (usually located in a control box in the furnace). By altering the fan control to lower "start" and "stop" temperatures, the blower fan will start sooner and run longer during the heating cycle. Hold the dial face of the limit control firmly and adjust the start and stop temperature setting pins to 49°C (120°F) and 32°C (90°F) respectively. **There is a third pin (usually fastened in place) which is the overheating pin limit shut-off. Do not alter the setting of this pin, normally set at 93°C (200°F) or above, as lowering it may cause the furnace to stop.**

Gravity Systems

Gravity furnaces have no fan to move the air. The action of heated air rising and cooled air falling circulates heat from the furnace.

The major maintenance for a gravity system is keeping the duct system clean and unobstructed. It is important that both supply and return ducts be free of any dirt buildup and that no furnishings block the grilles. Gravity systems usually rely on thermostats for temperature control, so lowering temperature settings at night will save energy.

Gravity furnaces are no longer manufactured. Most are quite old. The heat exchangers should be checked to ensure that they are still safe.

Hot Water (Hydronic) Systems

The layout of a typical residential hot water heating system is shown in Figure 7 on page 5. There are various systems (series loop, one pipe, two pipe, etc.) but most rely on a circulating pump to move water through baseboard convectors.

A minimum of maintenance is required. Lubrication of the circulation pump twice a year is important. Place a few drops of non-detergent electric motor oil into the oil cups at both ends of the motor and on the top of the bearing assembly between the motor and pump body (Figure 19).

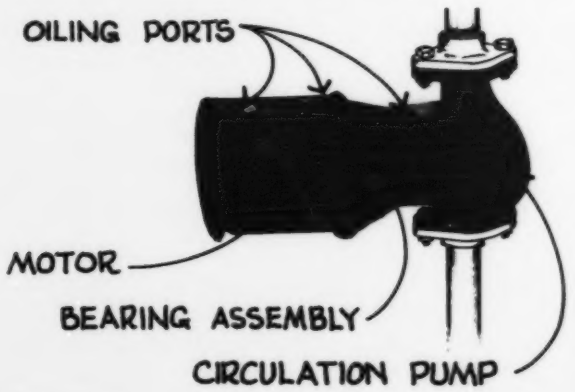


Figure 19

Other servicing includes bleeding air from the system, maintaining the water level and occasionally adding corrosion inhibitor. Procedures to add water and remove excess air vary among systems. Consult service manuals or a heating contractor.

Some old systems use gravity rather than a pump to circulate water. Adding a pump can increase efficiency by up to 30 per cent. The pump should be installed with a bypass to permit repair without draining the whole system.

Because the volume of water is often greater in gravity systems, get professional advice about the appropriate pump capacity.

If there is an aquastat (a water temperature control) on the boiler, consider reducing the minimum temperature to 50°C (120°F) during the warmer months of the heating season. The adjustment is done by turning a screw located on the body of the aquastat. This adjustment should not be done with stainless steel boilers or where the boiler also heats domestic water.

Thermostat Setback

You can save energy by turning down the furnace thermostat during the night to 17°C (63°F) instead of leaving it at 20°C (68°F) and by leaving it down during the day if no one is home. Each 1°C setback overnight, if done regularly during the heating season, will reduce the annual heating bill by one per cent.

Automatic setback thermostats ensure settings are altered each and every day. Override switches on the thermostats enable the bypass of automatically lowered settings, for example, on a weekend when everyone is home during the day.

Automatic setback thermostats use a 24-hour clock or timer programmed to raise and lower the settings for specified periods. Some units control two or three setback periods per day; others only one period. Many have optional five or seven-day programs so that weekends are programmed separately. Most replacement units use existing low voltage wires from the furnace. Check to see that the thermostat specifications match the voltage requirements stamped on the furnace nameplate.

Most automatic setback thermostats can be installed by the homeowner. Those that require additional wiring may be a problem if new wiring cannot be easily threaded through the wall. When installing or replacing a thermostat, place it on an inside wall away from drafts, direct sunlight or heat sources such as a refrigerator, heat ducts or a chimney behind the wall. Mount the thermostat about 1.5 metres (5 feet) from the floor and away from heavy traffic areas.

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Heating Systems

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